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[Michael Roberts, The Military Revolution, 1560-1660, p. 26-27]

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opening which more than compensated them for the loss of their own special military organization; and the more impoverished of them—the *hobereaux*, Junkers, *knapar*—were delighted to be relieved of the burden of supplying the expensive equipment of the heavy cavalryman, and glad to be able to find a full-time career in the king's service. It was not long before they attempted to claim, as a privilege of birth, an excessive share of the new opportunities. By the beginning of the eighteenth century, though the social escalator was still on the move, there was a widespread tendency to label it "Nobles Only", and this tendency was not wholly counteracted by the practice (prevalent in some countries) of ennobling non-noble officers who might attain to a certain grade.

Meanwhile, the arm which presented the aspiring soldier with the fewest social barriers was undoubtedly the artillery.¹ Empirical in method, generously approximate in effect, the artillery was nevertheless ceasing to be a "mystery", and was on the way to becoming a regular arm of the services, with a normal military organization: the first purely artillery regiment seems to have been established by Gustavus in 1629.² And behind the artillery lay a fringe of scientific laymen and minor mathematicians—those "mathematical practitioners" whose part in educating the seamen, gunners and surveyors of the age has recently been made clear.³ Indeed, one main element in the military revolution was the harnessing, for the first time and on a large scale, of science to war. The invention of corned powder towards the end of the sixteenth century gave to firearms a new effectiveness, and would have been still more important if the techniques of metallurgy had been able to take full advantage of this advance.⁴ A century of notable technical progress, nevertheless, lay behind the Swedish light artillery. Very soon after the invention

1. In the armies of the Great Elector, for instance, "the officers of the artillery and the engineers were almost exclusively commoners": Carsten, *op. cit.*, p. 271.
2. *Sveriges krig 1611-1632*, supplementary vol. II. 295.
3. E. G. R. Taylor, *The Mathematical Practitioners of Tudor and Stuart England*, (Cambridge, 1954).
4. A. R. Hall, *Ballistics in the Seventeenth Century. A Study in the Relationship of Science and War with reference principally to England*, (Cambridge, 1952), p. 16: "The standard of engineering technology was not merely insufficient to make scientific gunnery possible, it deprived ballistics of all experimental foundation, and almost of the status of an applied science, since there was no technique to which it could, in fact, be applied." Mr Hall's thesis is that in this century science could not effectively be applied to war; but he goes too far when he writes, "None of these inventions [for small arms] had the effect of modifying tactics" (p. 8): the wheel-lock pistol certainly did so. And while it may well be true that France's technical superiority in gunnery in the time of Colbert gave her no decisive advantage (p. 21), a similar superiority was certainly of decisive advantage to Gustavus Adolphus.

of a satisfactory portable telescope it was being used in the field by Maurice and Gustavus. The importance for military purposes of advances in cartography seems first to have been recognized by Stefan Bátori, who caused military maps to be drawn for him in the 1570's.¹ Inventors were assiduous in the production of new and more terrible weapons: Napier is famous not only as the father of logarithms, but as the inventor of submarines, gas-shells, and an armoured fighting vehicle; Jan Bouvy in his *Pyrotechnie militaire* (1591) described the first practicable torpedo;² multiple-barrelled guns were devised on all hands; the first hand-grenade seems to have been invented by Gilius Packet for Erik XIV in 1567;³ Maurice of Orange dallied with "saucisses de guerre", with saws fitted with silencer attachment (for nocturnal attacks upon fortresses), and with other devices more curious than effective.⁴ And soon after the end of our period Colbert was to found the *Académie royale des Sciences* with the avowed object of applying science to war.

These developments brought to an end the period in which the art of war could still be learned by mere experience or the efflux of time. The commander of the new age must be something of a mathematician; he must be capable of using the tools with which the scientists were supplying him. Gustavus consistently preached the importance of mathematics; Monro and Turner spoke slightly of illiterate old soldiers.⁵ And since war must be learned, institutions

1. M. Kukiel, *Zarys historii wojskowości w Polsce*, p. 46. For Gustavus's interest in cartography, see Försvarsstabens krigshistoriska avdelning, *Vägar och väghundskap i Mellanuropa under trettioåriga krigets sista skede*, (Stockholm, 1948), pp. 41-2.
2. *Krijgskundige Aantekening van Johan van Nassau*, p. xii.
3. L. Hammarskiöld, "Ur svenska artilleriets hävder", p. 93.
4. Saucisses de guerre are described by Johan of Nassau as "korbe welche langerlich und geflochten sint . . . mit eisernen schroten kugel oder kleinen steinen auffollet", and as "wurste welche voll pulvers gefullet und in die rustlöcher [of a fortress] so viel man dun kan, gesteckt, und die mauer also gesprengt werden". They are said to have been sacks an ell thick and ten to twelve feet long: *Krijgskundige Aantekening van Johan van Nassau*, pp. 50, 94 and note 2. They are possibly to be distinguished from "saucissons", described in a note to Montecuccoli (*Mémoires*, p. 137, note) as "grosses fascines liées en trois endroits".
5. Styffe, pp. 65, 67; Monro, II. 175, 196; and in general for military education W. Sjöstrand, *Grunddragen av den militära undervisningens uppkomst- och utvecklingshistoria i Sverige till år 1792*, (Uppsala, 1941). The concluding section of Wallhausen's *Art militaire à cheval* (pp. 97-134) is "a discourse of two persons . . . on the excellence of the Military Art, maintaining that (except Theology) it excels all the other arts and sciences, as well liberal as mechanical", and insisting that "the Military Art ought to be taught in Academies, as Letters are"; and Davies writes (*The Art of War and Englands Traynings*, p. 29) that the military profession "being then more perfect and aboue all other Arts, consequently it is necessarie we vse in the same greater Studie, and more continuall exercise then is to be used in any other Art".

